# University of Mumbai

No. AAMS_UGS/ICC/2024-25/06

**CIRCULAR:-**

Attention of the Principals of the Affiliated Colleges and Directors of the Recognized Institutions in Faculty of Science & Technology is invited to this office Circular No. UG/73 of 2018-19 dated 06th July, 2018 relating to the revised syllabus as per the (CBCS) for the Chemistry of T.Y.B.Sc. Physical Chemistry, Inorganic Chemistry, Organic Chemistry and Analytical Chemistry (Sem –V & VI) (3 and 6 units) including Applied Component Drugs and Dyes, Heavy Fine Chemicals and Petrochemicals.

They are hereby informed that the recommendations made by the **Board of Studies in Chemistry** at its meeting held on 11th May, 2024 and subsequently passed by the Board of Deans at its meeting held on 24th May, 2024 **vide** item No. 6.9 (R) have been accepted by the Academic Council at its meeting held on 24th May, 2024 **vide** item No. 6.9 (R) and that in accordance therewith, the **revised syllabus for T.Y.B.Sc. (Organic Chemistry) – Sem V & VI (CBCS)** has been brought into force with effect from the academic year 2024-25.

(The said circular is available on the University's website www.mu.ac.in).

Baliramh

MUMBAI – 400 032
25th June, 2024

(Prof. (Dr.) Baliram Gaikwad)
I/c. REGISTRAR

To,

The Principals of the Affiliated Colleges and Directors of the Recognized Institutions in Faculty of Science & Technology.

**A.C/6.9 (R) /24/05/2024**

Copy forwarded with Compliments for information to:-

1) The Dean, Faculty of Science & Technology,
2) The Chairman, Board of Studies **Chemistry**,
3) The Director, Board of Examinations and Evaluation,
4) The Director, Board of Students Development,
5) The Director, Department of Information & Communication Technology,
6) The Co-ordinator, MKCL,
7) The Deputy Registrar, Admissions, Enrolment, Eligibility & Migration Department (AEM),
8) The Deputy Registrar, Result Unit,
9) The Deputy Registrar, College Affiliations Development Department (CAD

**Copy to :-**

1. **The Deputy Registrar, Academic Authorities Meetings and Services (AAMS),**
2. **The Deputy Registrar, College Affiliations & Development Department (CAD),**
3. **The Deputy Registrar, (Admissions, Enrolment, Eligibility and Migration Department (AEM),**
4. **The Deputy Registrar, Research Administration & Promotion Cell (RAPC),**
5. **The Deputy Registrar, Executive Authorities Section (EA),**
6. **The Deputy Registrar, PRO, Fort, (Publication Section),**
7. **The Deputy Registrar, (Special Cell),**
8. **The Deputy Registrar, Fort/ Vidyanagari Administration Department (FAD) (VAD), Record Section,**
9. **The Director, Institute of Distance and Open Learning (IDOL Admin), Vidyanagari,**

**They are requested to treat this as action taken report on the concerned resolution adopted by the Academic Council referred to in the above circular and that on separate Action Taken Report will be sent in this connection.**

1. **P.A to Hon'ble Vice-Chancellor,**
2. **P.A Pro-Vice-Chancellor,**
3. **P.A to Registrar,**
4. **All Deans of all Faculties,**
5. **P.A to Finance & Account Officers, (F.& A.O),**
6. **P.A to Director, Board of Examinations and Evaluation,**
7. **P.A to Director, Innovation, Incubation and Linkages,**
8. **P.A to Director, Board of Lifelong Learning and Extension (BLLE),**
9. **The Director, Dept. of Information and Communication Technology (DICT) (CCF & UCC), Vidyanagari,**
10. **The Director of Board of Student Development,**
11. **The Director, Department of Students Walfare (DSD),**
12. **All Deputy Registrar, Examination House,**
13. **The Deputy Registrars, Finance & Accounts Section,**
14. **The Assistant Registrar, Administrative sub-Campus Thane,**
15. **The Assistant Registrar, School of Engg. & Applied Sciences, Kalyan,**
16. **The Assistant Registrar, Ratnagiri sub-centre, Ratnagiri,**
17. **The Assistant Registrar, Constituent Colleges Unit,**
18. **BUCTU,**
19. **The Receptionist,**
20. **The Telephone Operator,**
21. **The Secretary MUASA**

**for information.**

AC – 24/05/2024
Item No. – 6.9 (R)

# University of Mumbai

**Revised Syllabus for**

**T.Y.B.Sc. (Organic Chemistry)**

**Semester – (Sem V and VI)**

**(Choice Based Credit System)**

**(With effect from the academic year 2024-25)**

# University of Mumbai

## Syllabus for Approval

| | |
|---|---|
| **O: _____ Title of Course** | T.Y.B.Sc. (Organic Chemistry) |
| **O: _____ Eligibility** | As per University Ordinance |
| **R: _____ Passing Marks** | 40% |
| **No. of years/Semesters:** | Three |
| **Level:** | UG |
| **Pattern:** | Semester |
| **Status:** | Revised |
| **To be implemented from Academic Year :** | From Academic Year: 2024-25 |

**Sign of the BOS Coordinator**
**Dr. Sunil Patil**
**BOS in Chemistry**

**Sign of the Offg. Associate Dean**
**Dr. Madhav R. Rajwade**
**Faculty of Science & Technology**

**Sign of the Offg. Dean**
**Prof. Shivram S. Garje**
**Faculty of Science & Technology**

# Preamble

**1) Introduction**

The B.Sc (Chemistry) program is meticulously structured to foster a deep understanding of chemical principles and their real-world applications. The curriculum is a blend of theoretical knowledge and hands-on experience, ensuring that students not only grasp the core concepts but also develop a passion for the subject. With a focus on continuous assessment through quizzes, class tests, and assignments, the program emphasizes the importance of a strong conceptual foundation. This approach is complemented by practical experiments, where theoretical knowledge is applied, enhancing the learning experience and preparing students to tackle the multifaceted challenges in the field of chemistry.

**2) Aims and Objectives**

The B.Sc (Chemistry) program is structured to equip students with a comprehensive understanding of chemical principles and their real-world applications. It aims to foster a deep appreciation for the subject, encouraging students to engage in critical thinking and problem-solving. By integrating theoretical knowledge with practical skills, the course prepares graduates for diverse careers in research, industry, education, and beyond, contributing to their holistic academic and professional growth.

**3) Learning Outcomes**

A strong foundation in the fundamental principles of Physical, Inorganic, organic, and Analytical chemistry is essential for a successful career in the sciences. Continuous learning and self-improvement are critical for staying current in the ever-evolving field of chemistry. A curiosity-driven approach to scientific inquiry fosters innovation and discovery. Identifying potential career paths in chemistry-related fields opens up a world of opportunities in diverse industries. Applying acquired skills to entry-level positions can lead to significant advancements in sectors like pharmaceuticals, materials science, and environmental science.

4) **Any other point (if any)**

The program is meticulously designed to lay a solid foundation in the subject, equipping students with essential skills and knowledge. Through a blend of theoretical understanding and practical application, the curriculum aims to fortify the students' grasp of the basics, ensuring they are well-prepared for advanced study or professional application in the field. This foundational strength is crucial for their academic and career progression, providing a robust platform from which they can build expertise and specialization.

# T.Y.B.Sc. CHEMISTRY (6 UNITS)

Choice Based Credit System

To be implemented from the Academic year 2024-25

## Organic Chemistry

**SEMESTER V**

| **Course Code: USCH503** | **Credits: 02** | **Lectures: 60** |
|---|---|---|

| **Unit** | **Topic** | **No. of Lectures** | **Total No. of Lectures** |
|---|---|---|---|
| I | **1.1 Mechanism of Organic Reactions**<br>**1.1.1 The basic terms & concepts:**<br>Electrophilicity vs. acidity & nucleophilicity vs basicity.<br><br>**1.1.2 Neighbouring group participation in nucleophilic substitution reactions:**<br>Participation of lone pair of electrons, kinetics and stereochemical outcome.<br><br>**1.1.3 Acyl nucleophilic substitution (Tetrahedral mechanism):**<br>Acid catalyzed esterification of carboxylic acids ($AAC^2$) and base promoted hydrolysis of esters ($BAC^2$).<br><br>**1.1.4 Pericyclic reactions, classification and nomenclature.**<br>1.1.4.1 Electrocyclic reactions (ring opening and ring closing), conrotatory and disrotatory process. Woodward Hoffman rule. Cycloaddition, sigma tropic Rearrangement, group transfer reactions, cheletropic reaction (definition and one example of each type)<br>1.1.4.2 Pyrolytic elimination: Cope, Chugaev, | (10L) | 15 |

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| | | pyrolysis of acetates.<br><br>**Reference Books:**<br><br>1. A guidebook to mechanism in Organic Chemistry (Sixth edition), Peter Sykes, Pearson education, New Delhi.<br>2. Organic Reaction Mechanism (Fourth edition), V. K. Ahluwalia, R. K. Parashar, Narosa Publication.<br>3. Organic Reactions and their Mechanisms (Third revised edition), P. S. Kalsi, New Age International Publishers.<br>4. Advanced Organic Chemistry- Reactions Mechanism and Structure (Seventh edition), J. March and M. B. Smith, Wiley Student Edition. | | |
| | | **1.2 Photochemistry**<br>**1.2.1 Introduction:**<br>Difference between thermal and photochemical reactions. Jablonski diagram, singlet and triplet states, allowed and forbidden transitions, fate of excited molecules, photosensitization.<br><br>**1.2.2 Photochemical reactions of olefins:**<br>Photoisomerization, photochemical rearrangement of 1,4- dienes (di- π methane).<br><br>**1.2.3 Photochemistry of carbonyl compounds:**<br>Norrish I, Norrish II cleavages. Photo reduction (e.g. benzophenone to benzpinacol).<br><br>**Reference Books:**<br><br>1. Organic Chemistry (Seventh Edition), R.T. Morrison, R. N. Boyd & S. K. Bhattacharjee, Pearson.<br>2. Organic Chemistry (Eighth edition), John Mc Murry. | (5L) | |
| II | | **2.1 Stereochemistry I**<br><br>**2.1.1: Molecular chirality and elements of symmetry:**<br>Mirror plane symmetry, inversion center, roation - reflection (alternating) axis<br><br>**2.1.2: Chirality of compounds without a stereo genic center:**<br>Cummulenes and Biphenyls. | 5L | 15 |

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| | | **Reference Books:**<br><br>1. Stereochemistry of Carbon Compounds, E. L. Eliel, Tata McGraw Hill.<br>2. Stereochemistry Conformation and Mechanism (Eleventh Edition), P. S. Kalsi, New Age International Publishers.<br>3. Stereochemistry of Organic Compounds: Principles and Applications (Fourth Edition), D. Nasipuri, New Age International Publishers. | | |
| | | **2.2 Agrochemicals**<br><br>**2.2.1: General introduction & scope,** meaning & examples of insecticides, herbicides, fungicide, rodenticide, pesticides, plant growth regulators<br><br>**2.2.2: Advantages & disadvantages of agrochemicals**<br><br>**2.2.3: Synthesis & application of:** IAA (Indole Acetic Acid) & Endosulphan, Bio pesticides – Neem oil & Karanj oil.<br><br>**Reference Books:**<br><br>1. Insecticides & pesticides: Saxena A. B., Anmol publication.<br>2. Growth regulators in Agriculture & Horticulture: Amarjit Basra, CRC press 2000.<br>3. Agrochemicals and Pesticides: A. Jadhav and T.V. Sathe | 4L | |
| | | **2.3 Heterocyclic Chemistry**:<br><br>**2.3.1:** Reactivity of pyridine-N-oxide, quinoline and isoquionoline.<br><br>**2.3.2:** Preparation of pyridine-N-oxide, quinoline (Skraup synthesis) and iso-quinoline (Bischler- Napieralski synthesis).<br><br>**2.3.3:** Reactions of pyridine-N-oxide: halogenation, nitration and reaction with $NaNH_2$/liq.$NH_3$, n-BuLi. | 6L | |

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| | | **2.3.4:** Reactions of quinoline and isoquinoline; oxidation, reduction, nitration, halogenation and reaction with $NaNH_2$/liq.$NH_3$, n-BuLi.<br><br>**Reference Books:**<br>1. Name Reactions in Heterocyclic Chemistry, Jie-Jack Li, Wiley-Interscience publications, 2005.<br>2. Handbook of Heterocyclic Chemistry (Second Edition), Alan R. Katritzky and Alexander F. Pozharskii, Elsevier Science Ltd, 2000.<br>3. Heterocyclic Chemistry (Fifth Edition), John A. Joule and Keith Mills, Wiley publication, 2010.<br>4. Heterocyclic Chemistry (Third Edition), Thomas L. Gilchrist, Pearson Education, 2007. | | |
| III | | **3.1 IUPAC**<br>IUPAC Systematic nomenclature of the following classes of compounds (including compounds up to two substituents / functional groups):<br><br>**3.1.1 Bicyclic compounds** –<br>spiro, fused and bridged (up to 11 carbon atoms) – saturated and unsaturated compounds.<br><br>**3.1.2 Biphenyls**<br><br>**3.1.3 Cummulenes with up to 3 double bonds**<br><br>**3.1.4 Quinolines and Isoquinolines**<br><br>**Reference Books:**<br><br>1. Nomenclature of Organic Chemistry: IUPAC recommendations and preferred Names 2013, Henri A. Favre and Warren H. Powell- RSC publication.<br>2. IUPAC nomenclature (Second Edition), S. C. Pal, Narosa Publishing House pvt. Ltd. | 5 | 15 |
| | | **3.2 Synthesis of Organic Compounds**<br><br>**3.2.1 Introduction:**<br>Linear and convergent synthesis, criteria for an ideal synthesis, the concept of chemoselectivity and regioselectivity with examples, and calculation of yields.<br><br>**3.2.2 Multicomponent Synthesis:**<br>Mannich reaction and Biginelli reaction. Synthesis | 10 | |

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| | | with examples (no mechanism)<br><br>**3.2.3 Green Chemistry and Synthesis:**<br>Introduction: Twelve principles of Green Chemistry, concept of Atom Economy and E-factor, calculations and their significance, numerical examples.<br>i) Green reagents: dimethyl carbonate<br>ii) Green starting materials: D-glucose<br>iii) Green solvents: supercritical $CO_2$<br>iv) Green catalysts: Biocatalysts | | |
| | | **3.2.4 Some Green Methods of Organic Synthesis:**<br>Microwave-assisted Organic Synthesis (Using organic solvents and in solid state).<br>Ultrasound in Organic Synthesis, Phase transfer catalysis. | | |
| | | **Reference Books:**<br><br>1. Green Chemistry an introductory text (Third Edition), Mike Lancaster, RSC Publication.<br>2. Green Chemistry, V. K. Ahluwalia, Narosa Publishing House pvt. ltd.<br>3. New trends in Green Chemistry, V. K. Ahluwalia, M. Kidwai, Klumer Academic publisher.<br>4. An Introduction to Green Chemistry, V. Kumar, Vishal Publishing Co.<br>5. Organic Chemistry (Tenth Edition), Francis Carey, Tata Mc Graw Hill.<br>6. Organic Chemistry (Fifth edition), Carey and Sundberg, Springer. | | |
| IV | | **4.1 Spectroscopy I** | 7 | 15 |
| | | **4.1.1 Introduction:**<br>Electromagnetic spectrum, units of wavelength and frequency.<br><br>**4.1.2 UV – Visible spectroscopy:**<br>Basic theory, solvents, nature of UV-Visible spectrum, concept of chromophore, auxochrome, bathochromic and hypsochromic shifts, hyperchromic and hypochromic effects, chromophore-chromophore and chromophore-auxochrome interactions. | | |

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| | | **4.1.3 Mass spectrometry:**<br><br>Basic theory; Nature of mass spectrum; Importance of molecular ion peak, isotopic peaks, base peak, nitrogen rule, rule of 13 for determination of empirical formula and molecular formula; General rules of fragmentation. Fragmentation of alkanes and aliphatic carbonyl compounds.<br><br>**Reference Books:**<br><br>1. Organic Spectroscopy (Second edition), J. Mohan, Narosa Publication.<br>2. Introduction to Spectroscopy (Fifth edition), D. L. Pavia, G. M. Lampman, G. S. Kriz, J. A. Vyvyan, Cengage Learning Publication.<br>3. Elementary Organic Spectroscopy (Third edition), Y. R. Sharma, S. Chand Publication.<br>4. Organic Chemistry (Eighth edition), P. Y. Bruice, Pearson education.<br>5. Spectrometric Identification of Organic Compounds (Fifth edition), R.M. Silverstein, Wiley publication. | | |
| | 2) | **4.2. Natural Products**<br>**4.2.1 Introduction and broad classification of Natural products based on Chemical structure and physiological activity.**<br><br>**4.2.2 Terpenoids**<br>a) Introduction<br>b) Isoprene rule, special isoprene rule and the gem-dialkyl rule.<br>**4.2.3 Citral**<br>a) Structural determination of citral.<br>b) Synthesis of citral from methyl heptanone.<br>c) Isomerism in citral (cis and trans forms).<br>**4.2.3 Alkaloids**<br>a) Introduction and occurrence.<br>b) Hofmann's exhaustive methylation and degradation in**:** simple open chain and N – substituted monocyclic amines.<br>**4.2.5 Nicotine**<br>a) Structural determination of nicotine. (Pinner's work included).<br>b) Synthesis of nicotine from nicotinic acid.<br>c) Harmful effects of nicotine.<br>**Reference Books:**<br><br>1. Organic Chemistry of Natural Products, Vol I and | 8 | |

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| | | Vol II (First edition), A. Chatwal, Himalaya Publishing House.<br>2. Organic Chemistry Natural Products, Vol I and Vol II (First edition), O. P. Agarwal, Krishna Publications.<br>3. Chemistry of Natural Products (First edition), S. V. Bhat, B. A. Nagasampagi, M. Sivakumar, Springer Narosa Publication.<br>4. Organic Chemistry (Seventh edition), R. T. Morrison, R. N. Boyd and S. K. Bhattacharjee, Pearson Education.<br>5. Organic Chemistry, Vol II, (Fifth edition), I. L. Finar, Pearson Education.<br>6. Natural Products Chemistry (First edition), K. Nakanishi, T. Goto, Academic Press. | | |

# SEMESTER V PRACTICALS

| **Course Code: USCHP09** | **Credits: 02** |
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**A) Separation of Binary solid-solid mixture (2.0 gms mixture to be given).**

1. Minimum Six mixtures to be completed by the students.
2. Components of the mixture should include water soluble and water insoluble acids (carboxylic acid), water insoluble phenols (2-naphthol, 1-naphthol), water insoluble base (nitroanilines), water soluble neutral (thiourea) and water insoluble neutral compounds (anilides, amides, m-DNB, hydrocarbons).
3. After correct determination of chemical type, the separating reagent should be decided by the student for separation.
4. Follow separation scheme with the bulk sample of binary mixture.
5. After separation into component A and component B, one component (decided by the examiner) is to be analyzed and identified with m.p.

**Reference Books:**


1. Practical Organic Chemistry – A. I. Vogel
2. Practical Organic Chemistry – H. Middleton
3. Practical Organic Chemistry – O. P. Agarwal

# Organic Chemistry

## SEMESTER VI

| Course Code: USCH603 | Credits: 02 | Lectures: 60 |
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| Unit | Topic | No. of Lectures |
|---|---|---|
| Unit I | **1.1 Stereochemistry II** | **10L** |
| | **1.1.1 Stereoselectivity and stereospecificity:**<br>Idea of enantioselectivity (ee) and diastereoselectivity (de), Topicity: enantiotopic and diastereotopic atoms, groups and faces.<br><br>**1.1.2 Stereochemistry of –**<br>i) Substitution reactions: SNi (reaction of alcohol with thionyl chloride)<br>ii) Elimination reactions: E2–Base induced dehydrohalogenation of 1-bromo-1,2-diphenylpropane.<br>iii) Addition reactions to olefins:<br>a) Bromination (electrophilic anti addition)<br>b) Syn hydroxylation with $OsO_4$ and $KMnO_4$<br>c) Epoxidation followed by hydrolysis<br><br>**Reference Books:**<br><br>1. Stereochemistry of Carbon Compounds, E. L. Eliel, Tata McGraw Hill.<br>2. Stereochemistry Conformation and Mechanism (Eleventh Edition), P. S. Kalsi, New Age International.<br>3. Stereochemistry of Organic Compounds: Principles and Applications (Fourth Edition), D. Nasipuri, New Age International. | |
| | **1.2 Amino acids & Proteins** | **5L** |
| | **1.2.1 α-Amino acids:**<br>General Structure, configuration, and classification based on structure and nutrition. Properties: pH dependency of ionic structure, isoelectric point and zwitter ion. Methods of preparations: Strecker synthesis, Gabriel phthalamide synthesis.<br><br>**1.2.2 Polypeptides and Proteins:**<br>Nature of peptide bond. Nomenclature and representation of polypeptides (di-and tri-peptides) with examples, Merrifield solid phase polypeptide synthesis.<br>Proteins: General idea of primary, secondary, tertiary & quaternary structure<br><br>**Reference Books:**<br><br>1. Biochemistry (Eighth Edition), J. M. Berg, J. L. Tymoczko, G. J. Gatto, Jr. L. Stryer, W.H. Freeman Publication. | |

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| | 2. Principles of Biochemistry (Seventh Edition), D. L. Nelson and M. M. Cox, Lehninger, W. H. Freeman Publication.<br>3. Name Reactions (Fourth Edition), J. J. Li, Springer Publication. | |
| **Unit II** | **2.1 Molecular Rearrangements**<br>**Mechanism of the following rearrangements with examples and stereochemistry wherever applicable.**<br><br>**2.1.1 Migration to the electron deficient carbon:**<br>Pinacol-pinacolone rearrangement.<br><br>**2.1.2 Migration to the electron deficient nitrogen:**<br>Beckmann rearrangement.<br><br>**2.1.3 Migration involving a carbanion:**<br>Favorskii rearrangement.<br><br>**2.1.4 Name reactions:**<br>Michael addition, Wittig reaction.<br><br>**Reference Books:**<br><br>1. A guidebook to mechanism in Organic Chemistry (Sixth edition), Peter Sykes, Pearson education, New Delhi<br>2. Organic Reaction Mechanism (Fourth edition), V. K. Ahluwalia, R. K. Parashar, Narosa Publication.<br>3. Organic Reactions and their mechanisms (Third revised edition), P. S. Kalsi, New Age International Publishers.<br>4. Advanced Organic Chemistry- Reactions, Mechanism and Structure (Seventh edition), J. March and M. B. Smith, Wiley Student Edition. | **5L** |
| | **2.2 Carbohydrates**<br>**2.2.1 Introduction:**<br>Classification, reducing and non-reducing sugars, DL notation.<br><br>**2.2.2 Structures of monosaccharides:**<br>Fischer projection (4-6 carbon monosaccharides) and Haworth formula (furanose and pyranose forms of pentoses and hexoses).<br>Interconversion: open chain and Haworth forms of monosaccharides with 5 and 6 carbons. Chair conformation with stereochemistry of D-glucose, Stability of chair form of D-glucose.<br><br>**2.2.3 Stereoisomers of D-glucose:**<br>Enantiomer, diastereomers, anomers, epimers.<br><br>**2.2.4 Mutarotation in D-glucose with mechanism.**<br><br>**2.2.5 Chain lengthening & shortening reactions:**<br>Modified Kiliani-Fischer synthesis (D-arabinose to D-glucose and D- | **10L** |

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| | mannose), Wohl method (D-glucose to D-arabinose).<br><br>**2.2.6 Reactions of D-glucose and D-fructose:**<br>(a) Osazone formation (b) reduction: $H_2$/Ni, $NaBH_4$ (c) oxidation: bromine water, $HNO_3$, $HIO_4$ (d) acetylation (e) methylation<br>(d) and (e) with cyclic pyranose forms.<br><br>**2.2.7 Glycosides: general structure.**<br><br>**Reference Books:**<br><br>1. Organic Chemistry (Fourth edition), G. Marc Loudon, Oxford University press.<br>2. Introduction to Organic Chemistry (Fourth edition), Andrew Streitwieser, Jr. Clayton H. Heathcock, Macmillan publishing, New York.<br>3. Organic Chemistry (Sixth edition), Morrison and Boyd, Pearson Education.<br>4. Introduction to Organic Chemistry, John Mc Murry, Cengage Publisher.<br>5. Organic Chemistry, Volume- 1 & 2 (Fifth and sixth edition), I. L. Finar, Pearson Education. | |
| **Unit III** | **3.1 Spectroscopy II**<br>**3.1.1 IR spectroscopy:**<br>Basic Theory, Nature of IR spectrum, selection rule, finger print region.<br><br>**3.1.2 $^1$H-NMR spectroscopy:**<br>Basic theory of $^1$H-NMR, nature of $^1$H-NMR spectrum, chemical shift (δ unit), standard for $^1$H-NMR, solvents used. Factors affecting chemical shift: (1) inductive effect (2)<br>anisotropic effect (with reference to C=C, C≡C, C=O and benzene ring). Spin- spin coupling and coupling constant. application of deuterium exchange technique. application of H1-NMR in structure determination.<br><br>**3.1.3 Spectral characteristics of following classes of organic compounds, including benzene and monosubstituted benzenes, with respect to IR and $^1$H-NMR:**<br>(1) alkanes (2) alkenes (3) alkynes (4) haloalkanes (5) alcohols (6) carbonyl compounds (7) ethers (8) amines (broad regions characteristic of different groups are expected).<br>Problems of structure elucidation of simple organic compounds using individual or combined use of UV-Vis, IR, Mass and $^1$H-NMR spectroscopic technique are expected. (Index of hydrogen deficiency should be the first step in solving the problems).<br><br>**Reference Books:** | **10L** |

| | | |
|---|---|---|
| | 1. Organic Spectroscopy (Second edition), Jag Mohan, Narosa publication.<br>2. Introduction to Spectroscopy (Fifth edition), D. L. Pavia, G. M. Lampman, G. A. Kriz, J. R. Vyvyan, Cengage Learning.<br>3. Elementary Organic Spectroscopy (Third edition), Y. R. Sharma, S. Chand publication.<br>4. Organic Chemistry, Paula Y. Bruice, Pearson education.<br>5. Spectrometric Identification of Organic Compounds (Paperback – Illustrated, 29 Sept. 2014 English edition), Robert M. Silverstein, Francis X. Webster, David J. Kiemle, David L. Bryce, Wiley.<br>6. Absorption Spectroscopy of Organic Molecules, V. M. Parikh, Addison Wesley Publishing Company. | |
| | **3.2 Nucleic Acids**<br>Controlled hydrolysis of nucleic acids. sugars and bases in nucleic acids. Structures of nucleosides and nucleotides in DNA and RNA. Structures of nucleic acids (DNA and RNA) including base pairing.<br><br>**Reference Books:**<br><br>1. Organic Chemistry (Sixth edition), R. T. Morrison and R. N. Boyd, Pearson education.<br>2. Organic Chemistry (Fourth edition), S. H. Pine, Tata McGraw Hill. | **5L** |
| **Unit IV** | **4.1 Polymers:**<br>**4.1.1: Introduction**:<br>Terms monomer, polymer, homopolymer, copolymer, thermo plastics and thermosets.<br><br>**4.1.2: Addition polymers**:<br>Polyethylene, polypropylene, teflon, polystyrene, PVC, Uses.<br><br>**4.1.3: Condensation polymers**:<br>Polyesters, polyamides, polyurethanes, polycarbonates, phenol formaldehyde resins and uses of each one of these.<br><br>**4.1.4: Stereochemistry of polymers**:<br>Tacticity, mechanism of stereochemical control of polymerization using Ziegler Natta catalysts<br><br>**4.1.5: Natural and synthetic rubbers**:<br>Polymerisation of isoprene: 1,2 and 1,4 addition (cis and trans), Styrene butadiene copolymer.<br><br>**4.1.6: Additives to polymers**:<br>Plasticisers, stabilizers and fillers. | **8L** |

**4.1.7: Biodegradable polymers**:
Classification and uses. polylactic acid structure, properties and use for packaging and medical purposes.

(Note: Identification of monomer in a given polymer & structure of polymer for a given monomer is expected. condition for polymerization is not expected)

**Reference Books:**


1. Polymer Chemistry, M. G. Arora, K. Singh, Anmol Publications Pvt. Ltd.
2. Polymer Science, V. K. Ahluwalia and A. Mishra, Ane books.
3. Polymer Chemistry An Introduction, v.12, (Third edition), R. B. Seymour, C.E. Carraher, Marcel Dekker.


**4.2 Catalysts and Reagents**: **7L**
Study of the following catalysts and reagents with respect to functional group transformations and selectivity (no mechanism)

**4.2.1: Catalysts: Catalysts for hydrogenation**:

a. Raney Nickel
b. Pt and $PtO_2$ (C=C, CN, $NO_2$, aromatic ring)
c. Pd/C: C=C, COCl→CHO (Rosenmund)
d. Lindlar catalyst: alkynes

**4.2.2: Reagents:**

a. $LiAlH_4$ (reduction of CO, COOR, CN, $NO_2$)
b. $NaBH_4$ (reduction of CO)
c. $SeO_2$ (Oxidation of $CH_2$ alpha to CO)
d. mCPBA (epoxidation of C=C)
e. NBS (allylic and benzylic bromination)

**Reference Books:**


1. Organic Chemistry (Eighth edition), Francis A. Carey, R. M. Giuliano, McGraw Hill Education.
2. Advanced Organic Chemistry (Part A & B- Fifth edition), Francis A. Carey and Richard J. Sundberg, Springer.

# SEMESTER VI PRACTICALS

| Course Code: USCHP10 | Credits: 02 |
|---|---|

**A) Separation of Binary liquid-liquid and liquid- solid mixture.**

1. Minimum Six mixtures to be completed by the students.
2. Components of the liquid-liquid mixture should include volatile liquids like acetone, methyl acetate, ethyl acetate, isopropyl alcohol, ethyl alcohol, EMK and non-volatile liquids like chlorobenzene, bromobenzene, aniline, N, N- dimethylaniline, acetophenone, nitrobenzene, ethyl benzoate.
3. Components of the liquid - solid mixture should include volatile liquids like acetone, methyl acetate, ethyl acetate, ethyl alcohol, IPA, EMK and solids such as water insoluble acids, phenols, bases, neutral.
4. A sample of the mixture one ml to be given to the student for detection of the physical type of the mixture.
5. After correct determination of physical type, separation of the binary mixture to be carried out by distillation method using microscale technique.
6. After separation into component A and component B, the compound to be identified can be decided by examiner.

**Reference Books:**

1. Practical Organic Chemistry – A. I. Vogel
2. Practical Organic Chemistry – H. Middleton
3. Practical Organic Chemistry – O. P. Agarwal

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**Evaluation Pattern for Semesters V and VI**

**Semester End Theory Examination**

| Internal Continuous Assessment: 25% (25 Marks) | Semester End Examination: 75% (75 Marks) | Duration for End Semester Examination |
|---|---|---|
| **Continuous Evaluation through:** Quizzes, Class Tests, Presentations, Projects, Role Plays, Creative Writings, Assignments, etc. | As per following pattern | 2 hrs 30 minutes |

**Pattern for Semester End Examination (75 Marks):**

1. Duration - This examination shall be of **Two hours and 30 minutes** duration.

2. Theory question paper pattern:

   a. There shall be **05** questions each of **15 marks.**

   b. All questions shall be compulsory with internal choice within the questions.

| Question | Option | Marks | Based on Units |
|---|---|---|---|
| Q.1 | Subjective questions 3 out of 5 | 15 | Unit I |
| Q.2 | Subjective questions 3 out of 5 | 15 | Unit II |
| Q.3 | Subjective questions 3 out of 5 | 15 | Unit III |
| Q.4 | Subjective questions 3 out of 5 | 15 | Unit IV |
| Q.5 | A. True or False (Any Five out of Eight) | 05 | All Units |
| | B. Fill in the Blank with correct alternative. (MCQs with Four Options) (Any Five out of Eight) | 05 | |
| | C. Match the following (Any Five out of Eight) | 05 | |
| | Total | **75** | -- |

**Practical**

1. Total Marks for Practical Examination per major component is 50 Marks.
2. Every student shall perform **one experiment** from each Major Component
3. Scheme of Examination:
    a. Experiment : 40 Marks
    b. Journal : 05 Marks
    c. Viva-Voce : 05 Marks
    **Total : 50 Marks**

**Practical Book/Journal:**

The students are required to perform 75% of the Practical for the journal to be duly certified. The students are required to present a duly certified journal for appearing at the practical examination, failing which they will not be allowed to appear for the examination.

| | | |
|---|---|---|
| **Sign of the BOS Coordinator** | **Sign of the** | **Sign of the** |
| **Dr. Sunil Patil** | **Offg. Associate Dean** | **Offg. Dean** |
| **BOS in Chemistry** | **Dr. Madhav R. Rajwade** | **Prof. Shivram S. Garje** |
| | **Faculty of Science & Technology** | **Faculty of Science & Technology** |